



Xserve

Technology Overview
December 2006



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Introduction

What's new?

- 64-bit Dual-Core Intel Xeon “Woodcrest” processors running at up to 3.0GHz
- High-bandwidth server architecture including 4MB of shared L2 cache and dual independent 1.33GHz system buses per processor running at up to 10.5GB/s per channel
- 256-bit-wide memory controller supporting up to 32GB of 667MHz DDR2 ECC FB-DIMM memory
- Two eight-lane PCI Express expansion slots providing up to 2GB/s bandwidth per slot
- Flexible internal storage controller supporting SATA (Serial ATA) and SAS (Serial Attached SCSI), using hot-plug Apple Drive Modules supporting up to 2.25TB with SATA or 900GB with 15,000-rpm SAS¹
- Integrated “lights-out” remote management capabilities
- Optional dual redundant power supplies
- Built-in server-class graphics that simplify direct configuration and management
- Mac OS X Server v10.4.8, optimized for Intel processors, with unlimited-client access license

Make way for powerful, groundbreaking server technology from Apple. Yet again. Combining two Dual-Core Intel Xeon processors and Mac OS X Server software with innovative architecture and design, the all-new Xserve completes Apple's transition to Intel-based processing—while elevating the speed, performance, and flexibility possible in a server to astonishing levels.

Speed. At up to five times faster than Xserve G5, Xserve brings new meaning to the word “leap.”² Its two powerful 64-bit Dual-Core Intel Xeon “Woodcrest” processors are built to crunch. Running at up to 3.0GHz, they bring impressive compute power to the most demanding applications.

Performance. By any measure, Xserve delivers extraordinary performance per watt. That's due partly to the superfast processing at lower power consumption resulting from the Intel Core microarchitecture and 65-nanometer process technology. But just as important is the way that all high-performance Xserve components have been optimized to work together—the result of Apple's ingenious system design and powerful UNIX-based operating system, Mac OS X Server.

Every key component in Xserve has been chosen and engineered for performance and reliability. State-of-the-art hardware includes dual independent 1.33GHz system buses running at up to 10.5GB/s per channel, and new advanced main memory—up to 32GB—using a 256-bit-wide controller and 667MHz DDR2 ECC fully buffered DIMMs (FB-DIMMs). Built-in server-class graphics, an optional redundant power supply, and an intelligent cooling system providing super-efficient thermal management are some additional features that set Xserve apart.

The real key to unlocking its performance, however, is Mac OS X Server v10.4.8. In running full performance and 100 percent native on Intel hardware, Mac OS X Server delivers a host of enabling network services as well as new “lights-out” remote management and monitoring tools. And with an unlimited-client access license included with every Xserve, there are never any additional fees to worry about when new clients connect.

Flexibility. With more than 1 million possible configurations, Xserve is one of the most expandable and configurable 1U servers in the industry. Features include two eight-lane PCI Express 2GB/s expansion slots and three bays for holding an industry-leading amount of hot-pluggable internal storage—up to 2.25TB on SATA (Serial ATA) drives or up to 900GB on ultra-high-performance 15,000-rpm SAS (Serial Attached SCSI) drives. Xserve comes in one standard configuration, but there are so many available options that you can combine to meet your every need—from processor speeds to choices for drive types, storage capacities, and networking options.

The new Xserve builds on a history of continued innovation and improvement. Powerful, expandable, and affordable, it's perfect for meeting the demanding, changing needs of both small and large businesses, higher education and K–12 schools, creative departments, and science and technology research centers.

Product Overview



Xserve

Xserve packs quad Xeon computing power and fast, affordable storage into a 1U rack-optimized enclosure. With a single base configuration and a wide range of built-to-order options, customers can configure an Xserve to meet their specific needs.



Xserve RAID

Connect Xserve to Apple's affordable Xserve RAID storage solution for enormous capacity—up to 7TB¹—and advanced data protection in a high-availability 3U enclosure.

Key Features

Apple's fifth-generation rackmount server, Xserve combines leading-edge Intel processors, an advanced server architecture, flexible storage features, and powerful remote management features with Apple's legendary ease of use and the server software features of Mac OS X Server. The following features make Xserve a robust, versatile server solution for business and institutions everywhere.

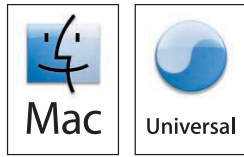
Two Dual-Core Intel Xeon processors. Xserve incorporates two Dual-Core Intel Xeon "Woodcrest" processors for a performance gain of up to five times over the previous-generation Xserve G5.² Each 64-bit Xeon processor has 4MB of shared L2 cache, compared with 512K on the PowerPC G5, and an enhanced 128-bit SSE3 vector engine.

Dual point-to-point system buses. Two independent frontside buses running at 1.33GHz provide a wide and fast path to system memory. These channels maximize processor performance by transferring instructions and data at a combined total throughput of up to 21.3GB/s.

Advanced memory technology. Xserve uses an advanced 256-bit-wide memory controller that uses four channels of 667MHz DDR2 fully buffered DIMMs (FB-DIMMs) with Error Correction Code (ECC) protection. This state-of-the-art memory subsystem provides up to three times the bandwidth of Xserve G5 and twice the capacity—up to 32GB. It also supports simultaneous reads and writes through the memory controller and other advanced high-availability features.

High-bandwidth server architecture. To deliver exceptional server performance, Xserve provides enhanced memory bandwidth, storage bandwidth, and I/O bandwidth to match the increase in processing performance. PCI Express on the logic board connects all key subsystems. It powers two 8-lane expansion slots, providing four times the I/O bandwidth of Xserve G5, and supports the latest high-bandwidth I/O cards, including Fibre Channel, graphics, and networking. Onboard I/O features also include dual Gigabit Ethernet ports, two FireWire 800 ports, a USB 2.0 port, and a serial port.

Flexible advanced storage. With three drive bays, Xserve provides an advanced 3Gb/s storage controller that supports both SATA (Serial ATA) and SAS (Serial Attached SCSI) internal storage capabilities. SATA drives provide outstanding value and excellent performance while delivering industry-leading capacity—up to 2.25TB using 750GB hard drives. Enterprise-class SAS hard drives deliver phenomenal performance—up to 126MB/s with seek times as low as 3.5 ms—and are ideal for demanding applications.³ In addition, optional PCI Express cards allow connection to external storage devices, including Apple's Xserve RAID storage system.



100 percent native

Mac OS X Server v10.4.8 runs 100 percent natively on Intel-based Mac systems. This means all services run at top speed and all Mac OS X Server features take immediate advantage of the two Dual-Core Intel Xeon processors in Xserve.

Built-in lights-out management. As long as the electrical power cord and Ethernet cable are plugged in, built-in remote management capabilities allow control of an Xserve system from anywhere on the network—even if the system isn't turned on. Easy-to-use Server Monitor software provides remote monitoring and control of Xserve with an easy-to-use graphical interface.

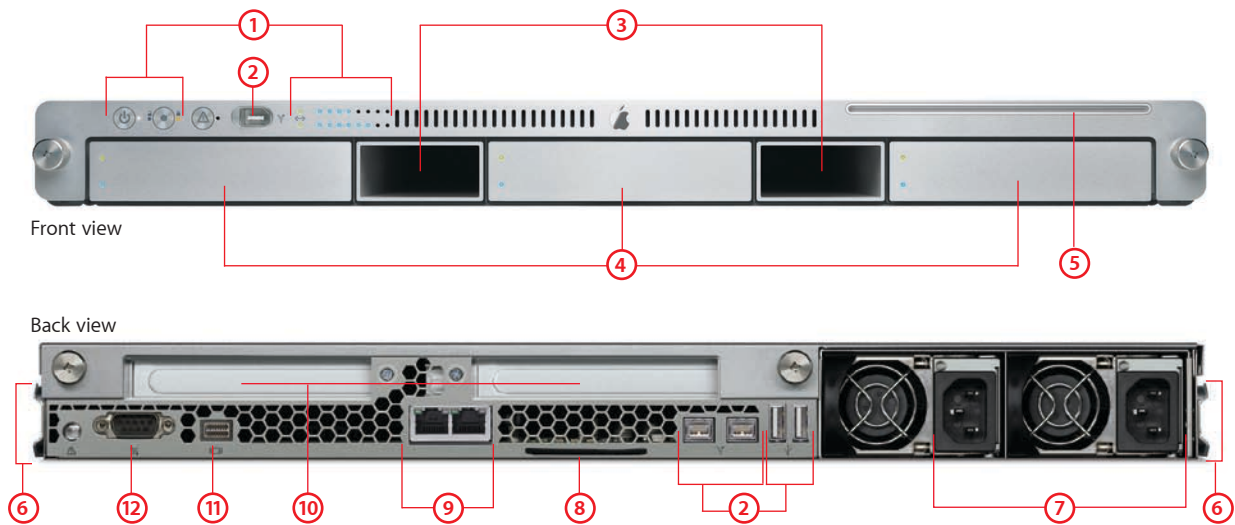
Powerful UNIX-based operating system. Included with Xserve at no additional cost is an unlimited-client license for Mac OS X Server. This native version—built on open standards and optimized to take advantage of the computing power of the 64-bit Dual-Core Intel Xeon—comes complete with easy-to-use workgroup and Internet services. It integrates seamlessly into enterprise infrastructures and never requires additional "client access license" (CAL) fees.

Server-class support products. To minimize downtime, Apple offers a suite of enterprise-class support products, including onsite hardware repairs, advanced software support, and convenient spares kits.

Advanced 1U Rack-Optimized Server Design

With enormous processing power and ample storage in a compact 1U-high, 19-inch-wide enclosure, Xserve is designed from the ground up for performance, serviceability, and easy integration into a wide range of computing environments. The necessary rackmounting hardware is in the box, including rack rails with sliders, mounting brackets for industry-standard four-post racks and cabinets, and complete setup instructions.

Xserve System



- 1 Indicator lights.** Indicator lights show system activity and also provide continuous feedback on health and status, including power, enclosure lock, drives, Ethernet links, and processor.
- 2 FireWire and USB ports.** Two back-panel FireWire 800 ports and one front-panel FireWire 400 port provide high-speed connectivity to storage, backup devices, and other servers. Two back-panel USB 2.0 ports connect standard peripherals.
- 3 Air ducts.** An intelligent cooling system—with large air ducts and seven high-performance double-blade fans, each individually managed by a microcontroller—provides front-to-back airflow over system components. For minimal noise and power use, the fans run only as fast as needed to cool the system effectively. If one fan fails, the others will speed up to compensate.
- 4 Drive bays.** Three bays support SATA and SAS internal storage on three independent channels. Hot-plug support allows storage to be added without bringing down the server. Apple Drive Module LEDs indicate drive activity and health using Self-Monitoring, Analysis, and Reporting Technology (SMART) data.
- 5 Optical drive.** The slot-loading 24x Combo drive (DVD-ROM/CD-RW) is convenient for fast software installation and recovery. The optional 8x double-layer SuperDrive (DVD+R DL/DVD±RW/CD-RW) permits quick and easy archive and backup.
- 6 Simplified rapid-mounting system.** An easy-to-use rackmount system with quick deployment rails simplifies and speeds installation of one or hundreds of systems, while supporting a wide range of racks and cabinets.
- 7 Redundant power supplies.** Hot-swappable and load-sharing, an optional second power supply for Xserve provides enhanced redundancy and easy serviceability in case one power supply fails.
- 8 System information tag.** Slide-out card provides key system information, including system configuration, serial number, and Ethernet MAC (Media Access Control) addresses in text and bar-code formats. An open area provides room for site-specific information or an organization's asset tag.
- 9 Gigabit Ethernet interfaces.** Dual independent Gigabit Ethernet links on the main logic board increase deployment and management flexibility.
- 10 PCI Express slots.** Two independent x8 PCI Express expansion slots provide four times the I/O bandwidth of Xserve G5, supporting the latest I/O and networking cards. The first slot can be configured to support a PCI-X card.
- 11 Internal graphics.** Built-in graphics—capable of driving up to a 23-inch Apple Cinema HD Display over DVI as well as standard VGA devices—provide administrators with convenient access without taking up an expansion slot.
- 12 Serial port.** A DB-9 serial port allows for system access through a serial console session, even when the network is down.

Performance Overview

The Xserve system is designed to deliver phenomenal performance with industry-leading ease of use and massive internal storage capacity. Thanks to its 64-bit quad Xeon processing power, advanced memory technology, and high-bandwidth architecture, Xserve easily handles demanding server operations. To assess its performance gains, Apple compared preproduction Xserve units with Xserve G5 systems.

Processor Performance

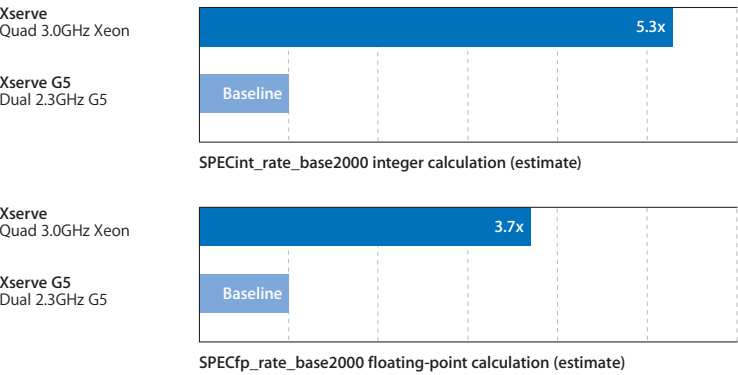
Leveraging the high throughput delivered by two 64-bit Dual-Core Intel Xeon processors and an enhanced 128-bit SSE3 vector engine, Xserve excels at managing the complex calculations crucial to users in business or scientific computing environments, image processing, and media encoding.

SPEC

SPEC rate metrics recognize multiple-core processors by running multiple copies of the benchmark code concurrently, allowing all cores to work in parallel. SPECfp_rate_base2000 and SPECint_rate_base2000 measure the number of times a system can complete a suite of floating-point and integer-math-based benchmarks, respectively, over a period of time. The performance of Xserve with the 3.0GHz Dual-Core Intel Xeon processor is an estimated 3.7 times faster in floating-point calculations than the 2.3GHz Xserve G5, and an estimated 5.3 times faster in integer calculations.

Benchmark performance: Up to five times faster than Xserve G5

Xserve is up to five times faster than Xserve G5 with integer calculations and nearly four times faster with floating-point calculations.



Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. Estimated SPECint_rate_base2000 score: 112.0 for quad 3.0GHz Xeon system and 21.1 for dual 2.3GHz G5 system. Estimated SPECfp_rate_base2000 score: 76.2 for quad 3.0GHz Xeon system and 20.4 for dual 2.3GHz G5 system. SPEC®, SPECfp®, and SPECint® are registered trademarks of the Standard Performance Evaluation Corporation (SPEC); see www.spec.org for more information. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

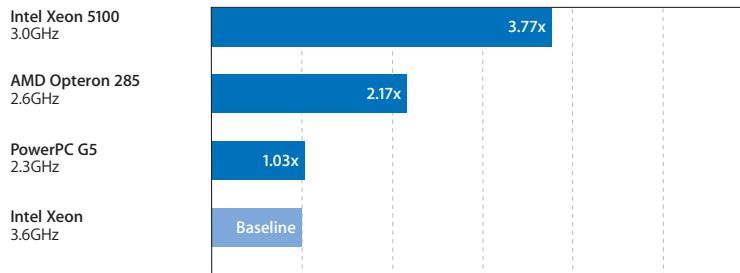
- To demonstrate the superior system performance of Xserve, Apple tested the system against Xserve G5 using popular computing benchmarks. The following results are based on benchmark testing performed in October 2006 by Apple in a laboratory setting using publicly available software. The server configurations tested were as follows:
- **Apple Xserve.** Two 3.0GHz Dual-Core Intel Xeon 5100 processors, 4GB of 667MHz DDR2 ECC FB-DIMM memory, single 80GB SATA Apple Drive Module, dual Gigabit Ethernet, and Mac OS X Server v10.4.7.
 - **Apple Xserve G5.** Two 2.3GHz PowerPC G5 processors, 4GB of 400MHz DDR1 ECC memory, single 80GB SATA Apple Drive Module, dual Gigabit Ethernet, and Mac OS X Server v10.4.7.

Performance-per-watt

Performance-per-watt is a measure of power efficiency, calculated by dividing the SPECint_rate_base2000 results by total TDP watts. With the 2.0GHz and 2.66GHz processors running at 65W per socket and the 3.0GHz processor running at 80W per socket, the Dual-Core Intel Xeon 5100 processor provides nearly four times the performance-per-watt versus the Xserve G5.

Benchmark performance: Industry-leading performance-per-watt

The new dual-core Xeon processors in Xserve are over three times more power efficient than previous Intel Xeon processors and nearly two times more efficient than the AMD Opteron 285.



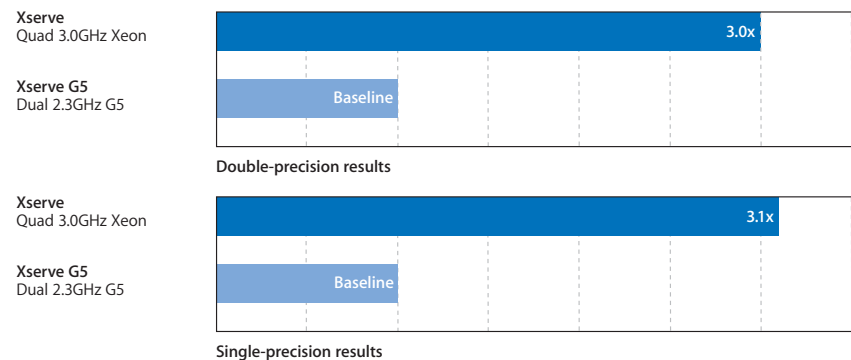
Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. Estimated SPECint_rate_base2000 score: 112.0 for quad 3.0GHz Xeon system and 21.1 for dual 2.3GHz G5 system. SPEC® and SPECint® are registered trademarks of the Standard Performance Evaluation Corporation (SPEC); see www.spec.org for more information. AMD Opteron and 3.6GHz Intel Xeon comparisons based on the best published SPECint_rate_base2000 results for each processor type as of November 9, 2006, and TDP (thermal design power) values available from public sources. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

LINPACK

Computers use double-precision floating-point mathematics to perform calculations requiring great numerical magnitude or extremely high decimal accuracy. Apple used the LINPACK benchmark to illustrate the benefits of the Dual-Core Intel Xeon processor's two floating-point units. LINPACK measures both single- and double-precision floating-point performance running a program that solves a dense system of linear equations.

Benchmark performance: Three times the floating-point performance of Xserve G5

Xserve is 3.1 times faster than Xserve G5 with single-precision floating-point calculations and three times faster with double-precision floating-point calculations.

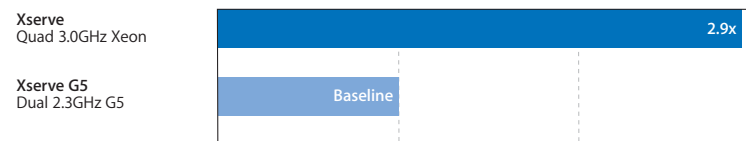


Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. All systems were configured with 4GB of RAM. Results are based on the 1000s and 1000d LINPACK benchmarks available from www.netlib.org/benchmark using a matrix size of 20,000 for the single-precision results and 16,000 (for quad Xeon-based Xserve) and 15,000 (for Xserve G5) for the double-precision results. All systems were tested using the Accelerate Framework. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

HMMER

HMMER is a set of popular bioinformatics applications that implement Hidden Markov Models—statistical models of multiple sequence alignments used in computational biology to search for patterns in DNA sequences. To test processor and memory performance in the new Xserve, hmmlibrate was run on Xserve G5 and Xserve against the same sample data set, then runtimes were compared.

hmmlibrate performance: Almost three times the performance of Xserve G5



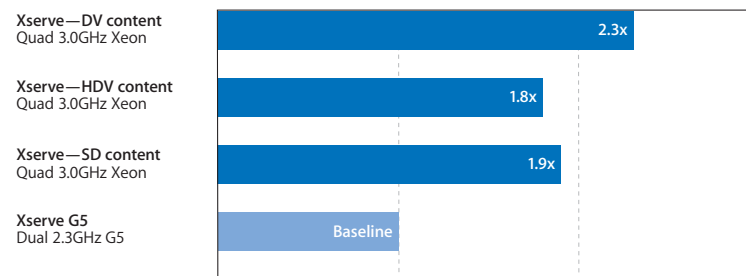
Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. For HMMER tests, Xserve G5 was tested with the binary distribution available at hmm.janelia.org; Xeon-based Xserve was tested with source compiled for Xserve using the patch available from www.scalableinformatics.com and the following compile-time options: -O3 -enable-threads. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

Video compression

Compressing video into popular delivery formats takes a tremendous amount of processor performance. Organizations looking to produce content in a variety of delivery formats can leverage batch processing software such as Apple's Compressor application, part of Final Cut Studio, on an Xserve to simplify and automate content compression and delivery. Apple tested a variety of video formats being encoded into MPEG-2 on Xserve and Xserve G5.

Compressor 2.3 results: MPEG-2 encoding performance

Xserve performs MPEG-2 compression up to 2.3 times faster than Xserve G5, depending on the source footage format.



Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. Compressor MPEG-2 6.2-Mbps two-pass encode settings were used. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

Memory Performance

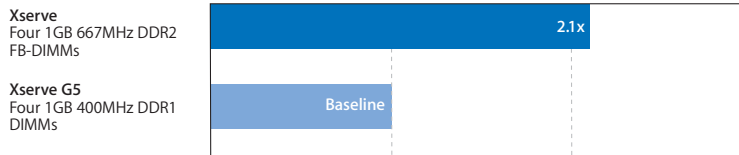
Xserve incorporates a new 256-bit-wide memory architecture that allows for higher speed, greater capacity, and better reliability. Using four channels of 667MHz DDR2 ECC fully buffered DIMMs, Xserve has a maximum memory bandwidth of 21.3GB/s. This added bandwidth gives an immediate boost to performance. With Xserve, enormous files and data sets can be loaded into RAM for rapid access by the two dual-core Xeon processors. A wide range of server services as well as graphics, video, and scientific applications benefit in particular, running dramatically faster as a direct result of more and faster RAM.

STREAM

The STREAM benchmark is a simple synthetic benchmark program that measures sustainable memory bandwidth in megabytes per second (MB/s). It measures sustained bandwidth, not burst or peak performance. Since the STREAM benchmark is specifically designed to work with data sets that are much larger than the available processor cache on any given system, the results are more indicative of the performance of applications using very large data sets.

Massive memory bandwidth

Xserve delivers more than twice the memory bandwidth of Xserve G5.



Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. All systems were configured with 4GB of RAM. Results are based on the STREAM v. 5.6 benchmark (www.cs.virginia.edu/stream/ref.html) using OMP support for multiprocessor-compiled builds and optimized for ICC (for quad Xeon-based Xserve) or XLC (for Xserve G5). Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

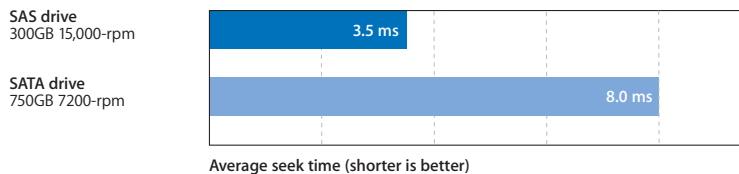
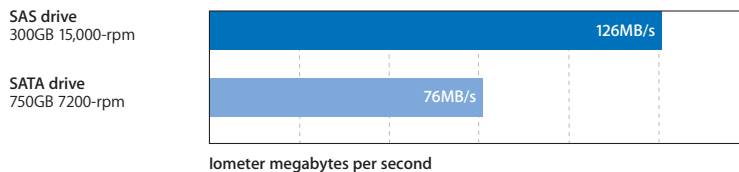
Storage Performance

While processor performance is a critical factor in scientific applications, most server workloads require a balance of processor, memory, disk, and network operations to deliver outstanding overall performance. Xserve delivers significantly upgraded storage capabilities compared with Xserve G5 by using a 3Gb/s-per-channel storage controller that supports both SATA (Serial ATA) and SAS (Serial Attached SCSI) hard drives. When configured with SATA drives, Xserve delivers tremendous value with excellent storage performance. When configured with 15,000-rpm SAS drives—the fastest and most reliable currently available in the industry—Xserve delivers maximum performance with ultrafast seek times for demanding applications.

Iometer

Iometer is an I/O performance analysis tool for servers that was originally developed by Intel and later released as an open source benchmarking tool. It measures system I/O performance—throughput as well as latency—while stressing the system with a controlled server workload.

Outstanding storage performance



Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units. Testing was conducted using Iometer 2004.0703 with a 30-second ramp-up, a 2-minute run duration, and a 512KB request size. Each system was configured as an OS + test disk configuration, where the OS resides on a single dedicated drive, and Iometer tests are performed against the second drive. Drive average seek time from published manufacturer specifications. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

When configured with the 750GB 7200-rpm SATA drive, Xserve delivers an outstanding 76MB/s per drive while supporting up to 2.25TB in a three-drive 1U enclosure. When configured with the 300GB 15,000-rpm SAS drive, Xserve delivers a breakthrough 126MB/s per drive with an average random access seek time of 3.5ms—ideal for high-workload applications like databases and mail servers.

Server Performance

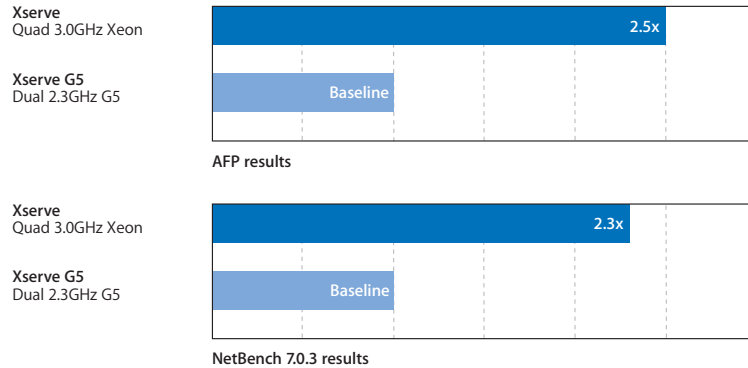
The balanced hardware architecture of Xserve provides a robust mix of processor, memory, storage, and network performance. Running Mac OS X Server software optimized for the Dual-Core Intel Xeon processor, Xserve can provide critical network and file services to large client populations—no matter whether Macintosh, Windows, or Linux clients. The advanced architecture and optimized operating system provide a dramatic increase in server performance.

File services

Delivering outstanding file server performance requires more than fast processors. The server system must also provide outstanding storage and network performance. Apple tested Xserve and Xserve G5 against the popular NetBench benchmark to test SMB/CIFS performance of the Samba stack built into Mac OS X Server, and ran an internal AFP testing tool against the AFP stack of both systems.

AFP and SMB performance

Xserve delivers up to 2.5 times the network file server performance running AFP and SMB services.



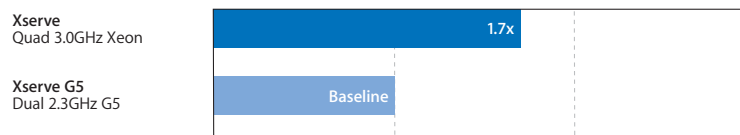
Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

MySQL performance

Databases require excellent memory performance and disk performance in addition to raw processor performance to perform well. Super Smack is a popular tool for MySQL used for benchmarking, stress testing, and load generation.

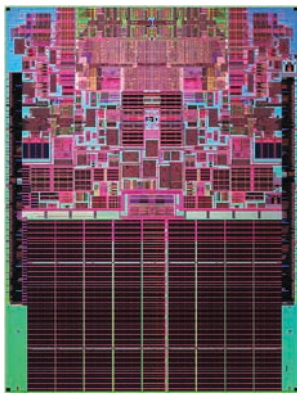
Super Smack 1.1

Xserve performs up to 1.7 times faster than Xserve G5 running MySQL.



Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. Results are based on the Super Smack 1.1 benchmark (vegan.net/tony/supersmack), with clients making a total of 1 million simple SELECT queries. Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

Dual-Core Intel Xeon Processors



Key features

- 64-bit processing
- Dual independent 1.33GHz system buses
- Wide Dynamic Execution
- Intelligent Power Capability
- 4MB Advanced Smart Cache
- Smart Memory Access
- Advanced Digital Media Boost

Inside every Xserve are two powerful new Dual-Core Intel Xeon processors running at up to 3.0GHz. Informally known during development as “Woodcrest,” they are the first 64-bit processors based on the next-generation Intel Core microarchitecture. Combining high performance and power efficiency, the new dual-core Xeon processors are ideal for a wide range of server workloads.

Quad Xeon Performance

Delivering industry-leading performance in a power-efficient design, the Xeon 5100 series processor helps make the new Xserve the most powerful Apple server ever. Providing up to five times the performance of Xserve G5, the processors are ideal for intense computing environments, 32-bit and 64-bit business-critical applications, and robust server platforms.²

Running at clock speeds of 2.0GHz, 2.66GHz, or 3.0GHz, each dual-core processor features a 1.33GHz independent frontside bus that maximizes system performance and delivers a combined system bus bandwidth up to 21.3GB/s. In addition, a massive 4MB of shared L2 cache increases performance by keeping data and instructions closer to the processor core. Cache memory is shared efficiently between the two cores without duplication of data, reducing system bus contention.

Built using Intel’s state-of-the-art 65-nanometer process technology, the Xeon processors are designed to deliver high performance at lower power consumption. With the 2.0GHz and 2.66GHz models running at 65W per socket and the 3.0GHz model running at 80W per socket, the Dual-Core Intel Xeon processor provides nearly four times the performance-per-watt of Xserve G5, for a significant reduction in power and HVAC bills.⁴

Next-Generation Microarchitecture

Intel Core is a new, multicore-optimized microarchitecture that sets new standards for energy-efficient performance. As implemented in the Dual-Core Intel Xeon processor, it incorporates a number of innovative features.

Wide Dynamic Execution

Intel Wide Dynamic Execution increases the number of instructions per clock cycle to improve execution time and energy efficiency. Every execution core is wider, allowing each core to fetch, dispatch, execute, and return up to four full instructions simultaneously. Further efficiencies include more accurate branch prediction, deeper instruction buffers for greater execution flexibility, and additional features to reduce execution time.

Increased energy efficiency

After labor, electricity and cooling create the highest costs for data centers. The 65-nanometer technology used in manufacturing Dual-Core Intel Xeon processors incorporates strained silicon to improve transistor performance and decrease power consumption. Less energy consumed means less heat dissipated—for increases in reliability and decreases in cooling system costs.

Intelligent Power Capability

Intel Intelligent Power Capability comprises a set of capabilities designed to reduce power consumption and design requirements. This feature manages the runtime power consumption of all the processor's execution cores. Advanced power gating allows for an ultra-fine-grained logic control that turns on individual processor logic subsystems only when they are needed. Also, many buses and arrays are split so that data required in some modes of operation can be put in a low power state when not needed.

Advanced Smart Cache

The Intel Advanced Smart Cache is a multicore-optimized cache. It improves performance and efficiency by increasing the probability that each execution core of a dual-core processor can access data from a higher-performance, more efficient cache subsystem. To accomplish this, the dual-core Xeon processor shares 4MB of L2 cache between cores. Unlike most multicore implementations, which leave each execution core to store data in its own L2 cache, Advanced Smart Cache optimizes cache resources by storing data in a single place that each core can access. By sharing L2 caches among multiple cores, the Intel Advanced Smart Cache also allows each core to dynamically utilize up to 100 percent of available L2 cache. When one core has minimal cache requirements, other cores can increase their percentage of L2 cache, reducing cache misses and increasing performance.

Smart Memory Access

Intel Smart Memory Access improves system performance by optimizing the use of data bandwidth from the memory and cache subsystem and hiding the latency of memory accesses. Most modern processors have prefetch engines that attempt to predict data needs and load the needed data from main memory into processor cache for faster retrieval. To do so, the processors must first resolve pending stores to main memory for in-flight instructions to prevent any data violations that could result in incorrect data being loaded or stored.

Intel Smart Memory Access provides a new capability called *memory disambiguation*. Utilizing advanced algorithms to evaluate whether a load can be executed ahead of a preceding store, this feature lets the processor spend less time waiting for memory and more time processing, resulting in faster execution and more efficient use of processor resources.

In addition, the Intel Core microarchitecture provides enhanced prefetch engines—two per L1 cache and two per L2 cache—that detect streaming and striding data patterns simultaneously. Smart Memory Access, using advanced prefetchers and advanced memory disambiguation, results in improved execution throughput by taking full advantage of available system bus bandwidth while hiding latency to the main memory subsystem.

Advanced Digital Media Boost

SIMD processing accelerates data manipulation by simultaneously applying a single instruction to multiple pieces of data. Whereas the PowerPC G5 processor uses the Velocity Engine to achieve this function, the dual-core Xeon processor incorporates an enhanced 128-bit Streaming SIMD Extensions (SSE) vector engine. Dual-Core Intel Xeon processors include 13 new SSE instructions in SSE3 under the name Advanced Digital Media Boost. On many previous-generation processors, 128-bit SSE, SSE2, and SSE3 instructions were executed at a sustained rate of one complete instruction every two clock cycles—for example, the lower 64 bits in one cycle and the upper 64 bits in the next. The Dual-Core Intel Xeon processor enables these 128-bit instructions to be completely executed at a throughput rate of one per clock cycle, effectively doubling

the speed of execution for these instructions. It accelerates a broad range of video, speech and image, photo processing, encryption, financial, engineering, and scientific applications.

64-Bit Processor Architecture

Working with Mac OS X, the 64-bit Intel Xeon architecture breaks through the 4GB memory limit of 32-bit processing. In fact, it's able to access virtually unlimited physical memory. It can manipulate data and execute instructions in chunks that are twice as large (64 bits versus 32 bits).

This all adds up to exceptional speed and agility, including the ability to perform multiple, simultaneous, 64-bit double-precision floating-point and huge integer calculations in every clock cycle. In contrast, a 32-bit processor must break these types of computations into multiple pieces, requiring multiple passes through the processor that slow down application performance.

The leap in performance from 32-bit to 64-bit processing brings previously unmanageable tasks into the realm of practicality. These include highly accurate calculations required for scientific analysis, technical research, 3D effects, and video encoding.

Multiple Cores and Mac OS X Server

Designed from day one for multiple processors, Mac OS X Server is ideally suited to leverage the power of multiple-core systems. With the symmetric multiprocessing, preemptive multitasking, and multithreading capabilities in Mac OS X Server, Xserve delivers groundbreaking system performance.

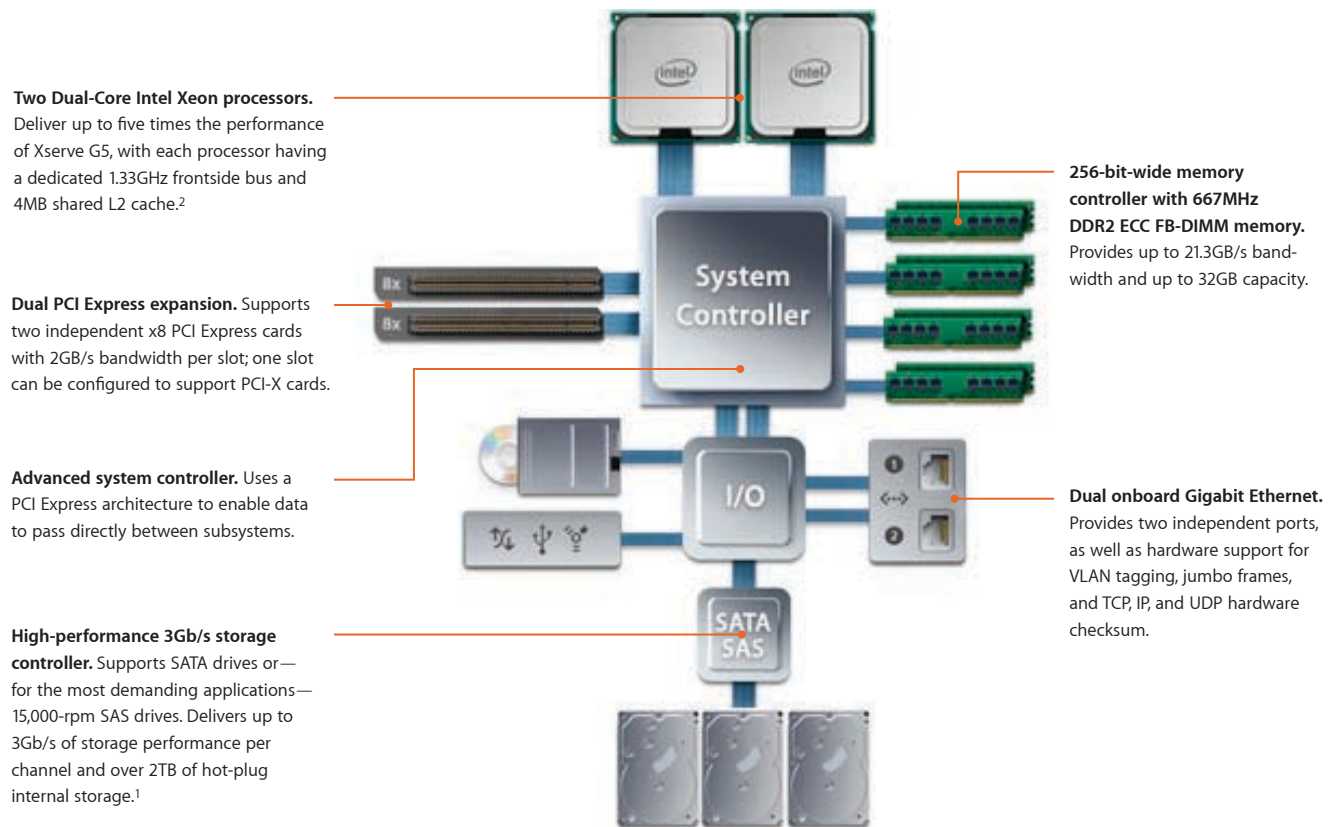
Symmetric multiprocessing (SMP) in Mac OS X Server dynamically manages tasks across multiple processors—and multiple processor cores—without requiring any special optimization of the application or any configuration on the administrator's part. With SMP, administrative tasks can be run in the background while the service tasks are running. Mac OS X Server assigns each of these tasks to a different processor or core for simultaneous execution, and automatically balances the load between processors.

Preemptive multitasking further optimizes performance by allowing Mac OS X Server to prioritize tasks on each processor or core.

Applications can take even greater advantage of multiple cores when they are written to be multithreaded. Most server applications, including Mac OS X Server services, are multithreaded, achieving significantly faster performance on multicore systems like Xserve.

High-Bandwidth Server Architecture

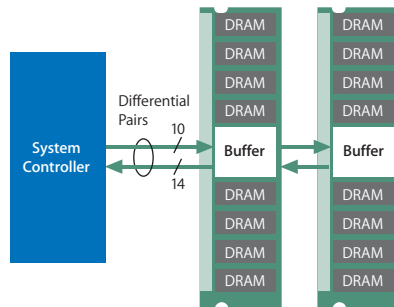
The Dual-Core Intel Xeon processor is only part of the Xserve performance story. Dual independent frontside buses keep data moving in and out of each processor, and a super-efficient system controller keeps data moving between all subsystems. Bandwidth is further enhanced by a 256-bit-wide memory controller and a PCI Express I/O architecture. Together these advanced technologies provide the performance and throughput for demanding Internet applications, robust network infrastructure solutions, and high-performance computational clustering environments.



Dual Independent 1.33GHz Frontside Buses

Xserve features dual independent 64-bit frontside buses—one bus per processor—to support a wide and fast path to system memory. The parity-protected buses feature a unique power-saving capability that powers down part of the bus when full bandwidth is not being utilized. Each channel runs at 1.33GHz independent of processor speed; combined they provide up to 21.3GB/s bandwidth.

Advanced FB-DIMM Memory Technology



What is a fully buffered DIMM?

A fully buffered DIMM, or FB-DIMM, is a new kind of high-performance computer memory module that helps increase a system's reliability, speed, and memory density while keeping down costs. Based on a high-speed point-to-point interface, it works with an Advanced Memory Buffer ASIC that allows full-speed, simultaneous reads and writes using industry-standard DRAM chips.

The fully buffered DIMM (FB-DIMM) is the next evolution in memory technology for servers and workstations that value both capacity and bandwidth. With older memory technologies, as signaling rates increase, the number of DIMMs supported per channel decreases. The result has been a trade-off between overall memory capacity and bandwidth. FB-DIMMs evade this trade-off by providing maximum capacity at the highest bandwidth.

The FB-DIMM is based on a high-speed point-to-point interface that uses an Advanced Memory Buffer (AMB) between the memory module and the memory controller. With high-speed serial communications, the number of wires needed to connect the chipset to the memory module is significantly lower. FB-DIMM memory channels require just 69 pins from the memory controller, compared with 240 pins for traditional parallel DDR2 memory. This efficiency allows more memory channels from the memory controller, increasing memory performance.

Previous memory technologies used a shared parallel interface with all DIMMs on the same bus. The AMB decouples the memory interface from the DRAM components, allowing the memory bus to run at high speed with more DIMMs. This also allows simultaneous reads and writes using industry-standard DDR2 DRAM chips.

The comparison of FB-DIMM communications to parallel memory communications is similar to the comparison of PCI Express communications to PCI or PCI-X parallel communications. PCI Express and FB-DIMMs use high-speed serial interfaces for communications and feature a reduced pin count and higher signaling rates. Both provide separate channels for data transmission and data reception, supporting simultaneous read and write operations. Both also provide higher bandwidth than their predecessors, use fewer communications lines (pins), take less space on the main logic board, and result in significantly greater system flexibility and increased capability for the end user.

In addition, FB-DIMM technology offers greatly improved reliability, availability, and serviceability (RAS) by complementing traditional ECC (Error Correction Code) data protection with CRC (cyclic redundancy checking) protection of the entire data path and an advanced SDDC (Single Device Data Correction) algorithm to enhance failure correction. FB-DIMMs perform CRC on the transfer of all addresses, commands, and data, and automatically retry when an error is detected. This allows for uninterrupted operation in case of transient errors. SDDC is performed by the memory controller to provide enhanced data protection and correction. The memory controller detects and corrects single-bit errors with ECC, but with SDDC, it can also detect and correct a complete failure of an x4 or x8 DRAM part on the FB-DIMM, as well as a two-wire failure on the DIMM, DIMM slot, or main logic board.

Quad-channel 256-bit-wide memory controller

Xserve incorporates a new 256-bit-wide memory controller that allows for higher speed, greater capacity, and improved reliability. Using fast 667MHz DDR2 FB-DIMM memory gives an immediate boost to application performance. When sets of four matched DIMMs are installed in Xserve, the memory controller utilizes all four memory

**4GB DIMM support**

Xserve supports 4GB DIMMs, allowing the system to accommodate up to 32GB of main memory.

channels for synchronized 256-bit memory transactions, further increasing performance. By comparison, Xserve G5 systems have a 128-bit memory controller and use 400MHz DDR1 memory.

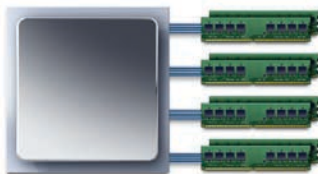
Memory capacity up to 32GB

Xserve provides twice the memory capacity—up to 32GB—of the Xserve G5. It also accomplishes this at up to three times the bandwidth of the 400MHz DDR1 memory in Xserve G5.

Advanced error protection

FB-DIMM technology offers higher reliability and better availability and serviceability. That includes powerful, enhanced data ECC protection, such as single-bit error correction and detection of multiple-bit errors. It also includes various other complementary high-availability features, such as ECC on-demand scrubbing, CRC on all transactions, and SDDC algorithms to detect and correct a single device failure.

- **Error Correction Code protection with on-demand scrubbing.** Automatically detects a single-bit error when read from main memory and detects (but doesn't correct) multiple-bit errors. When a cache line is read from main memory and a single-bit ECC error is detected, the memory controller will trigger an interrupt and log the error (including the DIMM number, which remote monitoring tools will also display), while automatically correcting it and passing its data along to the processor cache. As part of the correction process, a hardware memory scrubber immediately rewrites the value to correct the memory error in main memory. This feature prevents any future read of the same memory location from taking an ECC interrupt and impacting performance, while also trying to prevent a single-bit error from degenerating into a multibit error.
- **Enhanced CRC (cyclic redundancy checking) protection.** Checks the transfer of all addresses, commands, and data, and automatically retries the transaction when an error is detected, assuring uninterrupted operation in case of transient errors. Without the advanced error detection capabilities of FB-DIMMs, errors like this would halt the system.
- **Single Device Data Correction (SDDC).** Typical ECC memory subsystems can overcome single-bit errors only. Multiple-bit errors will panic and halt the system. Systems that support Chipkill technology enhance data correction capabilities by being able to deal with a single DRAM device failure if the DIMM is implemented with x4 DRAM parts. The memory controller in Xserve builds on these memory availability features by implementing an advanced error detection and correction algorithm called Single Device Data Correction (SDDC). This algorithm not only supports traditional ECC capabilities, but also detects and automatically corrects the failure of a single x4 or x8 memory DRAM on a fully buffered DIMM. It also supports detection of a two-wire fault on the DIMM connector or main logic board.
- **On-DIMM embedded diagnostics.** The Advanced Memory Buffer (AMB) ASIC on every FB-DIMM contains embedded diagnostics features, including error detection, error injection, and Built-In Self-Test (BIST). The features do not provide error protection during system runtime; rather they allow for extensive and quick diagnostics during system Power-On Self-Test (POST), during hardware testing with diagnostics software, and during factory testing and system qualification. These capabilities help ensure that system memory does not suffer from any hard failures in the AMB or DRAM components, or from any communications problems between the FB-DIMM and memory controller.

**Maximizing memory performance**

Using four memory channels, Xserve can use a 256-bit-wide memory architecture to achieve bandwidth up to 21.3GB/s. For the best system performance, memory should be installed in sets of four identical FB-DIMMs.

High-Performance PCI Express Expansion

Xserve features PCI Express expansion slots with up to four times the bandwidth of Xserve G5—ideal for connecting to high-performance networking, storage, cluster interconnect, graphics, and backup devices using optional expansion cards. Two independent eight-lane PCI Express slots provide 2GB/s of bandwidth each. Slot 1 can be configured to support a PCI-X expansion card through an optional expansion riser, preserving customer investments in expensive or custom cards and devices. An easy-access riser card with captive screws makes installing or removing expansion cards quick and easy, while increasing strength and support for larger cards.

	Technology	Length support	Power
Slot 1	x8 PCI Express (with PCI Express riser) 133MHz PCI-X (with optional PCI-X riser)	9 inches (22.86 cm)	25 watts
Slot 2	x8 PCI Express (with PCI Express riser)	6.6 inches (16.76 cm)	25 watts

Apple offers a wide range of expansion cards for Xserve, including Fibre Channel, Ultra320 SCSI, dual Gigabit Ethernet, and PCI Express graphics cards. The optional graphics card—an ATI Radeon X1300 with 256MB of RAM and dual-link DVI output—drives a 30-inch Apple Cinema HD Display and can support graphics, 3D, rendering, and visualization applications including Apple's professional applications like Final Cut Studio. This makes Xserve ideal for Xsan-based video workflow environments.

Industry-Standard Connectivity

Dual onboard Gigabit Ethernet

Apple extends the networking performance of Xserve with a high-performance Ethernet controller integrated into the I/O chipset. This advanced controller includes two independent 10/100/1000BASE-T Ethernet interfaces, each independently configurable for independent networks or teamed together with 802.3ad link aggregation built into Mac OS X Server. The result is tremendous networking bandwidth and no contention for data with the I/O subsystems.

In addition, the Gigabit Ethernet controller provides these networking features:

- Hardware-generated TCP, IP, and UDP checksum detects packet corruption and transmission errors.
- 802.1q VLAN (Virtual LAN) tags allow Xserve to be a member of multiple virtual networks and to provide unique network services to each one.
- A 48Kb buffer supports jumbo frames, or packets up to 9KB, to reduce system overhead and increase throughput of all network activities.

Dual Gigabit Ethernet ports deliver near-line-rate throughput of up to 980Mb/s per port, alleviating bottlenecks even with very large files, and expediting mail, web, file, and printer sharing services. Together with the multihoming function in Mac OS X Server, dual network ports enable Xserve to serve more client systems; provide redundant links; support a dedicated metadata network for Xsan; and support an isolated management network that is independent of a client services network. The dual network ports (in Xserve) enable the high-speed network interconnect. (Often one port is used for traditional networking and the second port for message passing interconnect in a cluster.)

Internal graphics

Administrators often need a quick way to plug in a display and access their servers. Xserve now offers built-in graphics as standard, no longer requiring the addition of a card that takes up a valuable expansion slot. The built-in graphics controller provides 64MB of RAM with a mini-DVI output and supports—over DVI—up to a 23-inch Apple Cinema HD Display. A mini-DVI to VGA adapter is included for connection to standard VGA devices and KVM (keyboard-video-mouse) switches.

Additional connectivity

Xserve offers industry-standard interfaces for a range of connecting I/O devices:

- **Dual FireWire 800 ports.** Two FireWire 800 ports on the back panel and one FireWire 400 port on the front panel connect to high-bandwidth FireWire (IEEE 1394) devices, such as storage devices and audio and video input devices. In addition, TCP/IP over FireWire can be used to create small clusters or an IP failover back-channel network, while FireWire target disk mode allows easy data migration and cloning of system configurations.
- **DB-9 serial port.** An industry-standard 9-pin serial port allows for system access through a serial console session.
- **Two USB 2.0 ports.** USB ports on the back panel connect to keyboards, mice, speakers, and other industry-standard peripheral devices.
- **Optical drive.** For software installation and recovery, a slot-loading 24x Combo drive (DVD-ROM/CD-RW) comes standard on server configurations. An optional 8x double-layer-burning SuperDrive (DVD+R DL/DVD±RW/CD-RW) is also available, permitting data archival and backup to DVD-R and DVD+R DL media.

Reliability Built In

From the 24/7-rated 3Gb/s Serial ATA drives, to the high-availability memory features, to the Apple quality workmanship and design throughout, Xserve is built from the ground up for reliability and long life. And make no mistake, those are crucial qualities in a server, because if the server goes down, so could the whole business or organization.

Dual power supplies

Hot-swappable and load-sharing, the redundant power supply option for Xserve provides greatly enhanced reliability. The power supplies are also easily serviceable in case of failure.

Memory RAS features

Advanced error correction features include ECC with on-demand scrubbing, CRC data and command protection with automatic translation retry, Single Device Data Correction (SDDC) supporting DRAM device failure correction, and embedded diagnostics.

Integrated software RAID

With powerful Mac OS X Server software, Xserve offers industry-leading integration of built-in software RAID to protect data on the internal hard drives, supporting such features as mirroring, booting off of the mirror, online rebuilding of the mirror, and more. Alternatively, use of Apple Xserve RAID provides high-throughput connectivity to external mass storage at a very competitive cost per gigabyte.

Industry-Leading Storage Flexibility

0 to 750 with perpendicular recording

The “bits” that constitute data have typically been recorded end to end, or longitudinally in a single plane on the surface of a hard drive’s recording platter. The new 750GB SATA drives offered with Xserve use state-of-the-art perpendicular recording technology to stack the bits vertically and in multiple planes, thereby achieving much greater capacity in a given area. Xserve accommodates three such drive modules to provide an astounding amount of internal storage capacity in a 1U form—up to 2.25TB.



SATA and SAS drive technologies

For internal storage, Xserve offers both SATA (Serial ATA) and SAS (Serial Attached SCSI) drive technologies. Very reliable and delivering great performance, SATA is the best choice when high capacity and cost per gigabyte are of primary and equal importance. When the ultimate in performance and reliability is required, SAS is the best choice, providing the industry’s highest reliability and performance for high-workload data.

Large databases, digital video footage, immense scientific data sets, and uncompressed video all place enormous demands on server storage resources. Addressing these growing requirements by providing an industry-leading capacity of up to 2.25TB of affordable internal storage,¹ Xserve offers characteristic storage performance and flexibility with three drive bays accepting hot-plug Apple Drive Modules. Like Xserve G5, the new Xserve offers SATA (Serial ATA) support, but upgraded to include the latest SATA hard drives—with increased performance, capacity, and value. And now Xserve supports SAS (Serial Attached SCSI) hard drives for the highest performance and most demanding applications.

With each Apple Drive Module on an independent drive channel and connected to a 3Gb/s storage controller, the Xserve storage subsystem scales without compromising performance. This unique architecture delivers the best balance of performance, reliability, capacity, and price.

SATA Drive Technology

Xserve makes significant advances in built-in server storage with features such as a sophisticated 3Gb/s SATA/SAS storage controller with a dedicated bus to each Apple Drive Module. Xserve continues to deliver incredible internal storage capacity and value, now supporting up to 2.25TB using new 7200-rpm 750GB Apple Drive Modules that employ state-of-the-art perpendicular recording technology.

Every SATA drive in Xserve is rated 24/7 server class for reliability and performance. The independent drive architecture in Xserve isolates the drives electrically, preventing a single drive failure from causing unavailability or performance degradation of the surviving drives—a common problem with multidrive parallel SCSI implementations. The end result is a storage architecture that provides tremendous throughput and excellent storage scalability.

SAS Drive Technology

Serial Attached SCSI storage, the next generation of SCSI technology, is designed for the most demanding storage applications. Providing higher sequential performance—over 126MB/s with 3.5-ms seek time—and far higher random performance than SATA drives, the new SAS capabilities are nothing short of phenomenal.³

The 15,000-rpm Apple SAS drives provide the highest storage performance available today. Rated enterprise class, they have best-in-class MTBF (mean time between failures) ratings. That means you can trust Xserve to deliver ultimate reliability for critical server environments and applications like email and database serving.

Because SAS has the same physical interface as SATA and leverages the hot-plug Apple Drive Module carrier, Xserve users can make a per-bay choice between the SATA or SAS drive. This unusual degree of flexibility means that Xserve can be configured for a broader range of applications and specific requirements, making the platform a better long-term choice for corporations and data centers.

Apple Drive Modules



Apple Drive Modules

Xserve uses reliable, easy-to-install, high-performance Apple Drive Modules to provide cost-effective, high-capacity system storage.

In Xserve, the three 3.5-inch hard drive bays support greater internal capacity and more flexible RAID options than offered by other servers in the same class. Apple Drive Modules are affordable and simple to add. Choose 80GB or 750GB SATA Apple Drive Modules running at 7200 rpm, or 73GB or 300GB SAS Apple Drive Modules running at 15,000 rpm.¹

Robust hot-plug connectors in Apple Drive Modules protect the connecting pins from bending when drives are inserted or removed. Hot plugging allows administrators to add storage without bringing down the server. Insert a new Apple Drive Module at any time and it's instantly available to the server. This convenience is made possible by tight integration between system hardware and software.

Apple Drive Modules feature a unique handle design for fast and easy installation; a positive locking mechanism holds them tightly in place after insertion. The drive carrier employs a drive mounting technique that increases drive isolation and reduces vibration, especially important for high-performance 15,000-rpm drives. Carefully tested and qualified to ensure maximum performance and reliability, Apple Drive Modules work seamlessly with the sophisticated Xserve monitoring sensors and Server Monitor remote monitoring software.

Monitoring of drive health

Xserve hardware and software work together to provide industry-leading remote monitoring and alert capabilities. The server operating system reads Self-Monitoring, Analysis, and Reporting Technology (SMART) data from each hard drive. SMART data allows the drive to report its health and enables Server Monitor software to warn the administrator of a prefailure condition—providing the opportunity to back up critical data and replace the hard drive before a failure occurs. For local monitoring, each Apple Drive Module has two LEDs, one for drive activity and one for drive health.

Software and Hardware RAID Options

Affordable and easy-to-install drive modules make it simple to expand Xserve systems to meet growing storage needs over time. For even greater storage capacity or to share storage among multiple servers, high-throughput PCI Express slots enable users to connect to external rackmount storage and backup systems, including Fibre Channel and SCSI devices and Apple Xserve RAID.

Software RAID in Mac OS X Server

Using software RAID built into Mac OS X Server, the three Apple Drive Modules can be striped or mirrored for improved performance or data redundancy.

- **RAID 0, or striping.** Increases storage performance dramatically by distributing data across two or three Apple Drive Modules and enabling the drives to read and write data concurrently. Drive striping takes full advantage of the three independent drive channels and utilizes the I/O capabilities of Mac OS X Server.



Xserve RAID, industry-leading price/
performance leader

- **RAID 1, or mirroring.** Provides a high level of data protection by creating a real-time, exact duplicate of the contents of one Apple Drive Module on a second drive. With the volume promotion feature in Mac OS X Server v10.4 or later, you can upgrade a single drive to a RAID 1 mirror without needing to reformat the drive and reinstall the operating system. If a mirrored drive fails, the system can rebuild the array in the background, while continuing to serve data. The independent drive architecture and software RAID combine to provide RAID 1 protection with no performance penalty.

For additional protection or higher performance, Mac OS X Server on Xserve can boot from a mirrored or striped volume.

Fibre Channel

Fibre Channel is the most sensible and reliable networking choice for any organization or business with growing data storage needs. Ideal for server applications, it has become the industry's de facto fast-switching system standard for moving highly scalable volumes of data at multi-gigabit speeds between computers, servers, disk arrays, and other devices. In addition, Fibre Channel is the only storage connectivity technology available today that guarantees bandwidth as well as in-order delivery of data packets—key requirements for streaming media such as video.

Xserve supports the Apple 2Gb Fibre Channel PCI Express Card, providing a high-speed storage interface with a dedicated bandwidth and throughput of up to 200MB/s per channel. Fibre Channel supports multiple topologies, further increasing storage options with Xserve. When used with the included SFP-to-SFP cables in a point-to-point configuration, Fibre Channel can directly connect a single Xserve RAID and achieve bandwidths on the order of 380MB/s across both channels.

Adding a Fibre Channel switch allows multiple Xserve RAID systems to be connected to a single Xserve, or multiple Xserve servers to be connected to one or more Xserve RAID systems—creating a simple storage area network (SAN). The addition of Apple's Xsan software results in a shared storage architecture that supports large, flexible storage pools with multiple servers and workstations sharing access to the same volumes and files.

Xserve RAID

For massive capacity and advanced data protection and availability features, Xserve connects to the Xserve RAID storage system using the Apple Fibre Channel PCI Express Card. Xserve RAID holds up to 14 hot-swap Apple Drive Modules, for up to 7TB of storage in a rack-optimized 3U enclosure.¹ The innovative Apple-designed architecture combines affordable, high-capacity ATA drive technology with a dual 2Gb Fibre Channel SFP interface for fast, reliable data access, even at distances of up to 500 meters. Redundant components further increase data protection and system availability. With easy-to-use tools for remote setup and management, this powerful RAID system provides a cost-effective answer to the growing storage requirements of businesses and institutions.

Apple 2Gb Fibre Channel PCI Express Card

The dual-port Apple 2Gb Fibre Channel PCI Express Card offers dedicated bandwidth with a throughput of up to 200MB/s per channel. Fibre Channel interconnect technology supports multiple application environments, using point-to-point, loop, and fabric topologies. Each card comes with two 2.9-meter (9.5-foot) copper cables.



Apple Fibre Channel PCI Express Card
Use the Apple Fibre Channel PCI Express Card to connect to an Xsan network and Xserve RAID for high-performance, high-availability storage.

Xsan

Xsan is a 64-bit cluster file system designed for small and large computing environments that demand the highest level of data availability. This specialized technology enables multiple Xserve systems, as well as Mac Pro workstations, to share RAID storage volumes over a high-speed Fibre Channel network. Each client can read and write directly to the centralized file system, scaling storage bandwidth while improving workgroup collaboration.

Enterprise-class features—such as metadata controller failover, Fibre Channel multipathing, and built-in volume management—make Xsan an ideal choice for storage consolidation and NAS replacement in data centers. Xsan is designed to provide file-level locking with concurrent read and write access, volume sizes up to 2 petabytes, and fine-grained permissions using access control lists (ACLs). Such robust features allow Xsan to scale out file services for a large number of users and to accelerate high-bandwidth workflows in film and video. In addition, thanks to groundbreaking prices, Xsan meets the low-cost requirements of computational clusters.

Whether in data centers, video post-production facilities, or high-performance computing environments, Xsan delivers these important benefits:

- **Storage consolidation.** Pool data across multiple RAID arrays for better performance and more efficient storage utilization.
- **High throughput.** Eliminate the bottlenecks of Ethernet-based networks.
- **Simultaneous read/write access.** Enable workgroups to collaborate easily and accomplish results faster than ever with concurrent file access.
- **Easy volume scalability.** Plug in more RAID devices as storage requirements grow—expanding the shared volume easily.
- **Increased data availability.** Eliminate single points of failure through metadata controller failover and Fibre Channel multipathing.

Xsan delivers all of this performance, flexibility, and scalability without the complexity—or the cost—of competitive SAN solutions.

Integrated Lights-Out Remote Management

Xserve includes built-in remote monitoring capabilities that enable network administrators to stay in touch with their Xserve systems from anywhere on the network or over the Internet. Enabled by hardware built into every Xserve system, the remote management system stays running as long as the system is plugged into power—even if the system is powered off or in a hung state. Xserve monitoring tools run securely over TCP/IP, using robust password authentication that is based on an enhanced version of the Intelligent Platform Management Interface (IPMI).



Remote management

Built-in remote management features in Xserve allow administrators to control and monitor information on hundreds of Xserve systems from any Internet-connected Mac OS X system.

Anywhere, Anytime Monitoring and Control

Forget about ever again having to trek to the server rack to control your server. Built-in lights-out management (LOM) capabilities allow remote control of an Xserve system from anywhere on the network or over the Internet. The system doesn't even have to be turned on, just plugged into power and Ethernet. And everything needed—hardware and software—is included with every Xserve, with no further purchase required.

Easy-to-use Server Monitor software provides complete remote access to and monitoring of Xserve, including reboot, power on, and power off. Remote Server Admin tools let you configure and monitor all key services of Mac OS X Server from near or far. If you prefer using a terminal window, Server Admin provides extensive command-line tools to configure, monitor, and manage your systems remotely using the preinstalled secure shell (SSH).

Built on industry standards, Xserve lights-out management conforms to version 2.0 of the IPMI specification, which will continue to improve server management and help reduce costs. IPMI helps lower the overall costs of server management by enabling customers to save time, maximize IT resources, and potentially manage multivendor environments in the same way. It also provides a highly secure environment for protecting management data and server deployments from unauthorized access.

Dedicated Monitoring Hardware

Built into the I/O controller of every Xserve main logic board is a dedicated, embedded microcontroller. This independently powered, fully out-of-band LOM processor can communicate directly to the host system or through the Ethernet channels in the I/O controller. This allows administrators to talk to Xserve even if it's powered off or has crashed. The system need only be connected to power and the Ethernet network.

For data centers with a serial terminal server infrastructure, Xserve also provides console access over built-in serial (DB-9) or Ethernet ports, supporting integration into existing server infrastructures. And if network services are down, UNIX-savvy administrators can access the system through a serial console session.



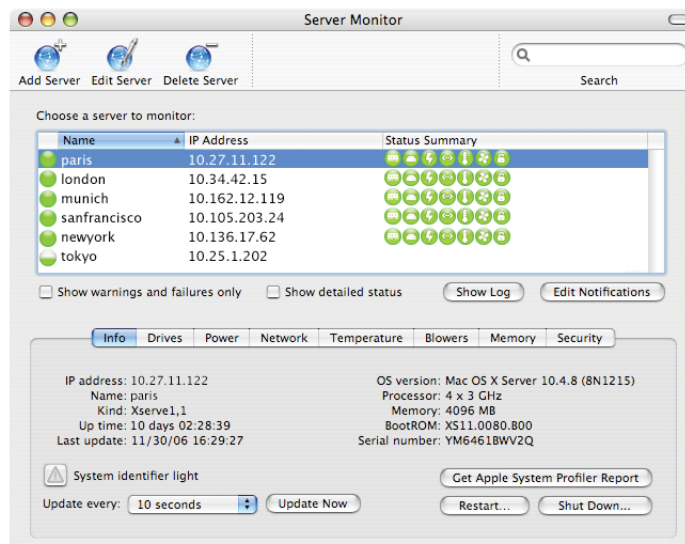
Automatic notifications

Server Monitor can send an email to alert specified individuals when operating conditions exceed predefined thresholds. Short text messages can be sent to email-capable pagers, cell phones, or PDAs; full-text details can be sent to email clients or full-function PDAs.

More than 100 embedded hardware sensors in the Xserve enclosure integrate with Apple's sophisticated Server Monitor software to check the condition of critical subsystems, such as memory, fans, power supplies, and Ethernet links. Temperature measurements for hard drives, processors, memory, PCI, power supply, and incoming ambient temperature are processed using a microcontroller and dedicated communications buses on the logic board.

Server Monitor Software

To maximize server uptime, Server Monitor software aids in the early identification and easy diagnosis of system problems. This powerful application uses data from the hardware sensors and the LOM processor to continuously report on the status of all Xserve subsystems, for servers on the network. If operating conditions for any component exceed predefined thresholds, Server Monitor can instantly send notification via email or email-capable pager, so network administrators can respond quickly to prevent or repair the problem.



Apple Xserve diagnostics

Xserve includes a server-class diagnostic tool that supports advanced hardware diagnostics. Capable of being run from the provided Admin Tools DVD, from a configured USB key, or through NetBoot, this powerful diagnostics tool provides an easy-to-use GUI that can be run locally or remotely.

Server Monitor can monitor hundreds of servers using a single, intuitive interface. Each server is identified by name and IP address (or DNS host name), and at-a-glance summary information (green indicates OK, yellow means warning, red alerts of an error) indicates the status of individual components. A click on any icon displays detailed status and performance information.

Server Monitor provides instant access to status and performance details, including these individual server attributes, subsystems, and system variables:

- **Info.** Lists key attributes of the server: name, IP address, device kind, operating system version, processor type, amount of memory, firmware version, uptime, last monitoring update, and hardware serial number.
- **Memory.** Displays the size, speed, and type of memory installed in each system, as well as ECC error counts.
- **Drives.** Provides the status of each of the server's hard drives, including SMART data for predictive failure notification.
- **Power.** Shows the current, voltage, and processor power, as well as a historical line graph for each supply rail. Also provides uninterruptible power supply (UPS) information and status when available.

- **Network.** Indicates the status of active network links, the network stack, and link settings and provides a historical line graph for each link.
- **Temperature.** Provides the values of the 10 enclosure and processor temperature sensors, as well as a historical line graph for each sensor reading.
- **Blowers.** Shows the revolutions per minute and status of the seven double-blade fans, including a historical line graph for each one. In the case of a single blower failure, the other fans speed up to compensate, allowing the server to continue to run, while also notifying the system administrator.
- **Security.** Displays the security status of the Xserve enclosure. Xserve features a hardware enclosure lock that prevents drives from being removed, as well as software-based I/O port security that allows administrators to disable optical mounting, removal of hard drives, or use of USB and FireWire devices.

In addition, Server Monitor records a log of activities and messages for each monitored Xserve. The log provides the times when Server Monitor attempted to contact the server and whether a connection was successful. It also shows changes in server status. For asset tracking or support logging, a System Profiler report can be saved for a selected server or multiple servers.

Apple Remote Desktop

A suite of integrated desktop and remote management tools, Apple Remote Desktop facilitates a wide range of IT tasks and simplifies the administrative process without compromising power and flexibility. Apple Remote Desktop complements the software and hardware features in Xserve, allowing administrators to manage one or hundreds of Xserve systems remotely with ease—distributing software, creating asset reports on hardware configurations or software versions, providing remote graphical screen control, and automating routine management tasks.

Apple Remote Desktop also complements the desktop and workgroup management features of Mac OS X Server, enhancing the remote administrative capabilities needed for any IT administrator supporting a population of Mac OS X client computers. Running detailed hardware or software configuration reports becomes an easy task, whether clients are on a local LAN or distributed across a multisite WAN. The same is true for upgrading software across a large user population or for providing remote assistance.

Apple integrated these essential IT management capabilities in an accessible interface, making it easy to discover and manage computers on a network and perform multiple management commands in sequence. For anyone managing a group of Mac computers, Apple Remote Desktop is an innovative application that streamlines workflow while reducing support costs, improving system management, and increasing security.

For extra convenience, Apple has enabled the Apple Remote Desktop agent on the Mac OS X Server installer DVD. This provides immediate remote control—with a superb graphical user interface—of Xserve installation for those who use Apple Remote Desktop.

And now, non-Apple machines can also control Xserve remotely. With Virtual Network Computing (VNC) features enabled, any open source VNC control application can be used to control Xserve remotely from a PC.



Apple Remote Desktop 3

Apple Remote Desktop enables you to control Xserve systems as well as Mac computers from anywhere on your network—even from a virtual private network from home. Because servers are often “headless” and in remote locations, Setup Assistant in Mac OS X Server includes a one-click option to install and configure the Apple Remote Desktop client. Also available is a command-line utility for configuring software on the server.

Apple Remote Desktop also supports the lights-out management (LOM) capabilities of the new Intel-based Xserve. You can remotely power on/off and restart the Xserve as well as obtain information on how the LOM is configured.

Mac OS X Server Version 10.4.8



Mac OS X Server v10.4.8 key features

- Intel Xeon–optimized kernel, services, and numerical libraries
- 64-bit MySQL
- Automatic Setup for configuring multiple servers
- ACLs for greater file sharing flexibility in mixed-platform environments
- Journaled HFS for enhanced server availability and fault resilience
- Server Admin application for easy setup and monitoring of services
- Open Directory for delivering enterprise directory and authentication services
- Single sign-on using Kerberos
- Samba 3 for supporting Windows users
- Postfix mail server for Mac and Windows users
- VPN server for Mac and Windows users
- Apple Remote Desktop agent with VNC support enabled on installer DVD
- JBoss application server for running J2EE-based applications
- 64-bit addressing that benefits application support
- Xgrid distributed computing architecture
- Xcode 2.4 development tools

Exclusive No-CAL model

With Mac OS X Server, customers never pay anything additional for client access licenses (CALs). In addition, other services, such as email and streaming media, do not require client licenses.

Xserve ships with Mac OS X Server version 10.4.8, the fifth major release of Apple's award-winning server operating system. Now Intel optimized, 64-bit, and with all services running 100 percent natively on Intel processors, Mac OS X Server provides open source, standards-based workgroup and Internet services without the complexity inherent in Linux and other UNIX-based solutions. An unlimited-client license means there are no additional per-seat fees for connecting more users. Hardware and software work together—all with a uniquely Apple ease of use—to deliver powerful, scalable solutions for supporting Mac, Windows, and Linux workgroups; for deploying powerful Internet services; and for hosting enterprise applications.

64-Bit Computing

Leveraging the 64-bit-enabled hardware on the Dual-Core Intel Xeon processor, Mac OS X Server brings the full power of 64-bit computing and optimized file services to mainstream servers. The 64-bit addressing, combined with 32GB of RAM support in Xserve, enables 64-bit applications to access massive amounts of memory. At the same time, 64-bit optimized math libraries provide high-performance, extremely accurate mathematical calculations.

Built-in Network Services

Mac OS X Server includes a complete suite of robust solutions for file and print, Internet and web, networking, workgroup management, and directory services. Apple has integrated and tested the latest open source technologies—such as OpenLDAP, Postfix, Apache, and JBoss—making them easy to deploy right out of the box.

Built on open standards, Mac OS X Server is compatible with existing network and computing infrastructures. Samba 3, the latest version of the popular open source SMB/CIFS server, provides reliable file and printer sharing for Windows clients, as well as support for NT Domain services. The built-in directory services architecture is based on LDAPv3, allowing Mac OS X Server systems to host LDAP directory services or integrate with any network that uses LDAP directory services. In addition, Mac OS X Server includes compatibility with legacy directory service solutions such as NIS, as well as proprietary solutions such as Active Directory. What's more, the open source UNIX-based foundation makes it easy to port and deploy existing tools to Mac OS X Server.

Innovative Remote Management

Mac OS X Server comes with innovative remote management tools that provide a consistent, unified interface for setting up and managing the built-in services. The Server Admin application enables network administrators to securely manage services on multiple servers at the same time—all from the same easy-to-use application.

Administrators can use Server Admin on any Internet-connected Mac OS X computer to install software updates (including system software), set preferences, and configure workgroup and Internet services—such as Samba 3, Apache, DHCP, Postfix, and QuickTime Streaming Server.

Mac OS X Server also makes it easy to monitor services remotely. Server Admin displays the current status of services running on Xserve systems. Administrators can read access and error logs, view charts of traffic patterns, and graph the performance of individual network services and file throughput—providing valuable information for planning and allocating network resources.

For administrators who prefer to manage from a terminal, Mac OS X Server includes Secure Shell (SSH2) technology for encrypted and authenticated login. Xserve is equipped with a DB-9 (9-pin) serial port, giving UNIX-savvy administrators a way to access the system through a serial console session, even when network services are down. Command-line tools allow administrators to remotely install software, run Software Update, or set system and network preferences. In addition, Mac OS X Server supports industry-standard Simple Network Management Protocol (SNMP) for integrating with third-party products such as HP OpenView.

High-availability services

To minimize downtime and maximize data protection, Mac OS X Server includes high-availability features such as software RAID, directory replication, file system journaling, a two-node IP failover service, and “watchdog” features such as automatic restart of the server and individual services.



Workgroups made easy

With powerful desktop management features built into the Mac OS X Server operating system, Xserve makes managing, securing, and imaging easy, plus provides centralized data access for collaboration.

Powerful Workgroup Management Services

Mac OS X Server provides services to Mac OS X clients that no other server platform can. Workgroups of any size can benefit from the management, system imaging, security capabilities, and collaboration features that integrate seamlessly with the desktop user experience.

Mac OS X Server includes Workgroup Manager, a suite of powerful tools for directory-based management of users, computers, and groups. Easy-to-use desktop management administration tools let you manage Mac systems from anywhere on the network. You can create standardized desktop configurations; set system preferences; establish password policies; automount home directories and group folders; and control access to hardware, software, and network resources.

By using Xserve to power your Mac OS X workgroup, you can streamline the support of Macintosh clients and reduce system administration costs through system imaging tools. Use NetBoot to host a standard operating system and application configuration on all of the desktop systems. For security-conscious organizations, NetBoot permits Mac computers to boot “disklessly”—without needing to read from or write to the computer’s local drive. Also, NetInstall is an ideal solution for installing software on the Mac OS X desktop and portable systems on your network.

The Software Update Server gives you extended flexibility in managing software updates. This streamlined process allows you to cache Apple software updates locally and lets you decide how and when users should view and download the software—reducing bandwidth consumption and saving the costs of multiple downloads.

Members of your workgroup can access their own personalized desktop, application, and files from any computer on the network, thanks to network-based home directories. Powerful file and print services, with features like quotas and access control lists, provide fine-grained management while delivering outstanding network performance. Providing centralized storage enables workgroup members to back up their work to a single location and allows mobile users to synchronize versions of home directory folders locally and on the network. It's a fast, easy, and reliable way to protect your data.



Integrated development for Mac OS X and Mac OS X Server

Apple's robust Xcode tools make it easy to build high-performance applications for the Dual-Core Intel Xeon processor.

64-Bit Software Development with Xcode

The Apple Xcode development toolset makes it easy to optimize applications for the dual execution cores of the Intel Xeon processor. Based on version 4 of the GCC (GNU Compiler Collection) development toolchain, Xcode is optimized for the latest Intel processors, taking full advantage of the Core microarchitecture features and capabilities, including the SSE3 extensions and the extra processor registers available in EM64T 64-bit modes.

Xcode and GCC are even multicore-aware themselves, automatically running in parallel for superfast compilation times. By recompiling with Xcode and the GCC 4 compiler, developers get improved code generation that keeps the processor's integer and floating-point units constantly fed with instructions.

Because Xcode supports the development of universal binaries, developers can build and qualify a single version of their applications for PowerPC- and Intel-based systems. In addition, GCC 4 includes auto-vectorization capabilities. Previously, developers had to create code for the vector processing unit by hand. Now the compiler can generate vector-based code automatically, delivering superior application performance while easing the developer's work.

For advanced performance optimization, Xcode includes Shark, a key component of the Computer Hardware Understanding Development (CHUD) tools. These powerful tools measure and evaluate performance, identifying specific areas of an application that can benefit significantly from the capabilities of the Dual-Core Intel Xeon processor. Shark enables you to very quickly identify where your application's performance problems lie, down to the specific functions on which you should concentrate your optimization efforts. You can then focus on the fixes that will yield the maximum benefits.

Shark supports performance analysis locally on the same system, remotely from another system over the network, and through a command-line interface, making it ideal both for local performance tuning on a single machine and for use on clusters. New to Shark is the "Windowed Time" facility, which allows Shark to analyze performance events that just happened by recording the past few seconds of the system execution. Since Shark and the gdb debugger can utilize symbol files in the DWARF format, you can optimize and debug production binary code without needing to recompile a specific debug version.

For more information about development resources for the Dual-Core Intel Xeon processor, visit developer.apple.com.

Intel compilers for Mac OS X

Intel provides C/C++ and Fortran compilers (icc, ifort), Math Kernel Library (MKL), Integrated Performance Primitives (IPP), and the new Intel Threading Building Blocks library for Mac OS X. Delivering outstanding performance for Intel multicore processors, these compilers and tools can be run from the command line or as plug-ins to Xcode. See www.intel.com/software for more information.

Service, Support, and Training Options

Every Xserve comes with a one-year limited warranty and 90 days of up-and-running telephone support. In addition, the AppleCare website publishes in-depth product information, training on hardware and software installation and configuration, and technical resources, including the AppleCare Knowledge Base, discussions, and downloadable software on Apple's Featured Software site.

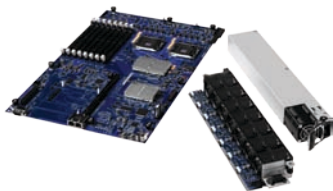
For critical server deployments, Apple also offers a comprehensive range of service and support options for Xserve hardware and Mac OS X Server software. For more information about these AppleCare products, visit www.apple.com/server/support.

AppleCare Premium Service and Support Plan

This server-class support product provides up to three years of up-and-running telephone and email support and onsite hardware service. Apple technical support experts are available 24 hours a day to help you determine whether you're experiencing a hardware failure or a Mac OS X Server configuration issue. In either case, Apple will work to get systems up and running quickly. And because Apple hardware and software are uniquely integrated, there's only one vendor to call.

The AppleCare Premium Service and Support Plan delivers up-and-running telephone and email support within 30 minutes—24 hours a day, 7 days a week. The hardware repair coverage provides global onsite response within 4 hours during business hours and next-day onsite response when you contact Apple after business hours (terms apply).⁵ For added peace of mind, you'll have the assurance that Apple-authorized technicians will perform repairs using genuine Apple parts.

The AppleCare Premium Service and Support Plan can be purchased at any time while Xserve is still under its original one-year warranty. However, since coverage ends three years after the hardware purchase date, you'll get maximum advantage when you make both purchases at the same time.



Convenient replacement modules

Problem resolution is fast with AppleCare Service Parts Kits for Xserve (sold separately).

AppleCare Service Parts Kit

Xserve is designed for quick serviceability of crucial parts; no special tools, training, or certifications are needed. AppleCare Service Parts Kits let system administrators keep key components handy to address the most common hardware failures. Each kit has a logic board, a power supply, and a fan array. When the AppleCare Premium Service and Support Plan is combined with an AppleCare Service Parts Kit, technical support experts can often help troubleshoot and fix systems right over the phone—day or night—eliminating the need for an onsite technician.

Mac OS X Server Maintenance Program

This subscription program makes it easy to manage software expenditures while benefiting from the latest technologies and improvements. With one easy payment, you'll receive major Mac OS X Server software upgrades for three years.

Mac OS X Server Software Support

Apple offers support programs for Mac OS X Server that extend beyond the up-and-running support provided by the AppleCare Premium Service and Support Plan. Apple technical support experts can provide consultative phone and email support for Mac OS X Server integration and migration issues, as well as help with command-line configuration.

Three levels of Mac OS X Server Software Support are available, depending on the number of incidents supported and desired response time. Each plan provides one year of coverage.

- **Select** covers up to 10 incidents with 4-hour response⁶ for priority 1 issues (server down), 12 hours a day, 7 days a week. Support for additional incidents can be purchased as needed.
- **Preferred** covers an unlimited number of incidents with 2-hour response⁶ for priority 1 issues, 12 hours a day, 7 days a week, and assigns a technical account manager to the organization.
- **Alliance** covers an unlimited number of incidents at multiple locations with 1-hour response⁶ for priority 1 issues, 24 hours a day, 7 days a week. This plan includes an onsite review by an Apple technical support engineer.

Apple Professional Services

Some organizations have requirements that go beyond basic installation services and may be looking for expertise in fulfilling a turnkey solution. Apple Professional Services addresses these needs with experts who can help assess technology needs and provide onsite deployment, best practices, and integration services.

For more information about Apple Professional Services capabilities and offerings, visit www.apple.com/consulting.

Training and Certification Programs

Apple offers comprehensive instruction on Mac OS X and Mac OS X Server, covering such topics as client management, system troubleshooting, and cross-platform network configuration. A combination of lectures, demonstrations, and hands-on exercises, classes are taught by Apple Certified Trainers with real-world experience and dynamic presentation skills. Classes are offered at Apple Authorized Training Centers, as well as at customer locations.

Once IT professionals have acquired the requisite skills, Apple certification programs provide tangible evidence of their technical expertise. For more information about Apple training and certification programs, visit www.apple.com/training.

Product Details

Capable of being tailored to a wide range of application environments, the new Xserve is the most configurable Xserve ever. Building on a base configuration that has two 2.0GHz dual-core Xeon processors, 1GB of FB-DIMM RAM, and an 80GB SATA drive module, many options are available to meet different server workloads and budgets.

Xserve Base Configuration

Order number	MA409LL/A
Processors	Two 2.0GHz Dual-Core Intel Xeon 5100 processors
Frontside bus	1.33GHz frontside bus per processor
L2 cache	4MB shared L2 cache per processor
Memory	1GB of 667MHz DDR2 ECC FB-DIMM memory (two 512MB modules)
Hot-plug storage	Three drive bays with one 80GB 7200-rpm SATA drive installed
Optical drive	24x Combo drive (DVD-ROM/CD-RW)
I/O connectivity	Two built-in Gigabit Ethernet interfaces (10/100/1000BASE-T); two FireWire 800, two USB 2.0, and one DB-9 serial port on back panel; one FireWire 400 port on front panel
Graphics	Built-in ATI Radeon X1300 PCI Express graphics with 64MB of GDDR3 SDRAM and mini-DVI output; mini-DVI to VGA adapter included
Expansion slots	Two open expansion slots: one half-length (6.6-inch) x8 PCI Express slot and one 9-inch configurable slot (x8 PCI Express or 133MHz PCI-X)
Power	Single 650W power supply
Software	Mac OS X Server version 10.4 Unlimited-Client Edition
Service and support	90 days of telephone support and one-year limited warranty

Configuration Options

Xserve—custom-configured to exact requirements—can be ordered from the Apple Store or an Apple Authorized Reseller. Options include the following:

Processors	Two 2.66GHz or 3.0GHz Dual-Core Intel Xeon 5100 processors
Memory	Up to 32GB of DDR2 ECC memory using 512MB, 1GB, 2GB, and 4GB FB-DIMM modules
Hot-plug storage	<p>Any combination of SATA or SAS Apple Drive Modules; up to 2.25TB using three 750GB SATA drive modules; or up to 900GB using three 300GB SAS drive modules.</p> <p>The following drive modules are available:</p> <ul style="list-style-type: none">• 80GB 7200-rpm SATA Apple Drive Module with 8MB cache• 750GB 7200-rpm SATA Apple Drive Module with 16MB cache• 73GB 15,000-rpm SAS Apple Drive Module with 16MB cache• 300GB 15,000-rpm SAS Apple Drive Module with 16MB cache
Optical drive	SuperDrive (DVD+R DL/DVD±RW/CD-RW)
Expansion cards	<ul style="list-style-type: none">• Apple Fibre Channel PCI Express Card• Apple Dual-Channel Gigabit Ethernet PCI Express Card• Apple Dual-Channel Ultra320 SCSI PCI-X Card• ATI Radeon X1300 PCI Express graphics card with 256MB of DDR2 memory and dual-link DVI port
Power	Optional second load-sharing 650W power supply for redundancy
Service and support	Optional extended service and support products

Related Products

- Xserve RAID, available in 1TB, 3.5TB, and 7TB configurations¹
- Xsan
- Apple Remote Desktop 3
- AppleCare Premium Service and Support Plan
- AppleCare Service Parts Kit
- Mac OS X Server Maintenance Program
- Third-party products, including racks, switches, and UPS devices

For up-to-date information on these and other products that enhance Xserve deployments, visit www.apple.com/store or call 800-MY-APPLE.

Technical Specifications

Hardware

Processing

- Two 2.0GHz, 2.66GHz, or 3.0GHz Dual-Core Intel Xeon 5100 processors featuring:
 - Wide Dynamic Execution
 - Intelligent Power Capability
 - 4MB Advanced Smart Cache per processor
 - Smart Memory Access
 - Advanced Digital Media Boost
- Independent 1.33GHz frontside bus per processor

Memory

- Advanced 256-bit-wide memory architecture with four fully buffered DIMM (FB-DIMM) channels featuring:
 - ECC (Error Correction Code) logic with on-demand error scrubbing
 - CRC (cyclic redundancy check) protection for commands and data
 - SDDC (Single Device Data Correction) algorithm
- Eight DIMM slots supporting up to 32GB of 667MHz DDR2 ECC memory using the following (pairs required; four or eight identical DIMMs recommended for best performance):
 - 512MB FB-DIMMs
 - 1GB FB-DIMMs
 - 2GB FB-DIMMs
 - 4GB FB-DIMMs

I/O connections

- Two open PCI Express expansion slots; one half-length (6.6-inch) x8 PCI Express slot and one 9-inch configurable slot (x8 PCI Express or 133MHz PCI-X)
- PCI Express and PCI-X cards available from Apple:
 - Apple Fibre Channel PCI Express Card
 - Apple Dual-Channel Gigabit Ethernet PCI Express Card
 - Apple Dual-Channel Ultra320 SCSI PCI-X Card
 - ATI Radeon X1300 PCI Express graphics card with 256MB of DDR2 memory and dual-link DVI port
- Two independent 10/100/1000BASE-T (Gigabit) RJ-45 Ethernet interfaces on main logic board
- Built-in ATI Radeon X1300 PCI Express graphics board with 64MB of GDDR3 memory and single-link mini-DVI port; mini-DVI to VGA adapter included
- Two FireWire 800 ports on back panel and one FireWire 400 port on front panel; 15W total power
- Two USB 2.0 ports (480Mb/s each)
- One DB-9 serial port (RS-232)

Storage

- Three internal drive bays with independent SATA and SAS channels, up to 3Gb/s each
- Up to 2.25TB of hot-plug internal storage using SATA Apple Drive Modules or up to 900GB using SAS Apple Drive Modules¹; Apple Drive Modules are server-class rated for 24/7 operation and are available in the following capacities:
 - 80GB 7200-rpm SATA with 8MB disk cache
 - 750GB 7200-rpm SATA with 16MB disk cache
 - 73GB 15,000-rpm SAS with 16MB disk cache
 - 300GB 15,000-rpm SAS with 16MB disk cache
- Support for reading SMART data from Apple Drive Modules for prefailure notification
- Slot-loading Combo drive (DVD-ROM/CD-RW) or optional SuperDrive (DVD+R DL/DVD±RW/CD-RW)

Rack support

- Fits EIA-310-D–compliant, industry-standard four-post racks and cabinets: 19 inches wide; 24 to 36 inches deep
- Front-to-back cooling for rack enclosure

Electrical

- Output power: 650W
- Optional second load-sharing 650W power supply for redundancy
- Line voltage: universal input (100V to 240V AC), power factor corrected
- Maximum input current: 8.0A (100V to 120V) or 4.0A (200V to 240V); current is shared when system is configured with two power supplies
- Frequency: 50Hz to 60Hz, single phase

Environmental

- Operating temperature: 50° to 95° F (10° to 35° C)
- Storage temperature: –40° to 116° F (–40° to 47° C)
- Relative humidity: 5% to 95% noncondensing
- Maximum altitude: 10,000 feet
- FCC Class A approved

Size and weight

- Height: 1.73 inches (4.4 cm)
- Width: 17.6 inches (44.7 cm) for mounting in standard 19-inch rack
- Depth: 30 inches (76.2 cm)
- Weight: 31.7 pounds (14.4 kg) for base configuration; 38.3 pounds (17.4 kg) for system with eight FB-DIMMs, three 300GB SAS Apple Drive Modules, and two power supplies⁷

Software

Mac OS X Server v10.4.8

- Unlimited-client edition

Included services

- File and printer sharing: Mac (AFP, AppleTalk PAP), Windows (SMB/CIFS), UNIX and Linux (NFS, LPR/LPD), Internet (FTP, WebDAV)
- Directory services: Open Directory 2 (OpenLDAP, Kerberos, SASL), NT Domain Controller (Samba 3), Backup Domain Controller (BDC)
- Networking and security: DNS server (BIND 9), DHCP server, NTP server, Firewall (IPFW), WINS, VPN server (L2TP, PPTP)
- Mail services: SMTP (Postfix), POP and IMAP (Cyrus), Berkeley DB for indexing, SSL/TLS encryption (OpenSSL), mailing lists (Mailman), webmail (SquirrelMail), junk mail filtering (SpamAssassin), virus detection and quarantine (ClamAV)

- Web hosting: Apache web server, SSL/TLS (OpenSSL), WebDAV, server-side includes (SSIs), PHP, Perl, Ruby, Python, MySQL 4
- Application services: JBoss application server (EJB), Apache Tomcat (JavaServer Pages, Java Servlets), Java virtual machine (J2SE), Apache Axis (SOAP, WSDL Web Services), WebObjects 5.2 Deployment
- Media streaming: QuickTime Streaming Server (H.264, 3GPP, MPEG-4, MP3, AAC, RTP/RTSP), QuickTime Broadcaster, QuickTime Streaming Server Publisher, unicast and multicast
- Collaboration services: iChat Server, Weblog Server
- Workgroup management: Workgroup Manager, NetBoot, NetInstall, Software Update Server
- Remote management: Server Monitor, Server Admin, SNMPv3, Secure Shell (SSH2), command-line tools
- Distributed computing: Xgrid

For More Information

For more information about Xserve, Xserve RAID, Mac OS X Server, Xsan, and other Apple server solutions, visit www.apple.com/server.

For more information on AppleCare service and support products, visit www.apple.com/support/products.

Performance tests are conducted using specific computer systems and reflect the approximate performance of Xserve.

¹For hard drive capacity measurements, 1GB = 1 billion bytes and 1TB = 1 trillion bytes; actual formatted capacity less. Maximum capacity of 2.25TB achieved through use of three 750GB Apple Drive Modules. ²Based on tests conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units and shipping dual 2.3GHz Xserve G5 units. Estimated SPECint_rate_base2000 score: 112.0. Estimated SPECfp_rate_base2000 score: 76.2. See www.spec.org for more information. ³Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units. Testing was conducted using Iometer 2004.0703 with a 30-second ramp-up, a 2-minute run duration, and a 512KB request size. Each system was configured as an OS + test disk configuration, where the OS resides on a single dedicated drive, and Iometer tests are performed against the second drive. Drive average seek time from published manufacturer specifications. ⁴Testing conducted by Apple in October 2006 using preproduction quad 3.0GHz Xeon-based Xserve units; Xserve G5 systems were shipping units. Estimated SPECint_rate_base2000 score: 112.0 for quad 3.0GHz Xeon system and 21.1 for dual 2.3GHz G5 system. AMD Opteron and 3.6GHz Intel Xeon comparisons based on the best published SPECint_rate_base2000 results for each processor type as of November 9, 2006, and TDP (thermal design power) values available from public sources. ⁵A separate AppleCare Premium Service and Support Plan must be purchased for each Xserve system to be covered. To qualify, systems must be within the one-year hardware warranty. Coverage ends three years after date of Xserve purchase. Actual onsite response time and availability of onsite service depend on location; see www.apple.com/support/products/premium for details. Local telephone fees may apply; telephone numbers and hours of operation may vary and are subject to change. ⁶Response times are not guaranteed. ⁷Weight varies by configuration and manufacturing process.

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